Chapter 19
Habits and Autism: Restricted, Repetitive Patterns of Behaviour and Thinking in Autism

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Leo Kanner, a child psychiatrist among the first to describe autism, noted in his observations of autistic children in 1973 that: 'they had in common a combination of extreme aloneness from the beginning of life and an anxiously obsessive desire for the preservation of sameness. They were described by their parents as "living in a world of their own"; they were little routine addicts, living in a world in which nobody other than themselves was allowed to make any changes so far as their daily lives were concerned'.

Autism (also called Autism Spectrum Disorder, ASD, or Asperger syndrome) is a neurodevelopmental condition affecting around 1–2% of the population, and is present from the early years of life and affecting an individual across the lifespan. Autism is a pervasive neurodevelopmental disorder characterised by impairments in two domains: (1) Social communication and interaction; and (2) Restricted, repetitive patterns of behaviour, interests or activities (American Psychiatric Association (APA), 2013). It has been included in modern classification systems for more than 40 years (since DSM-III APA, 1987) and an expanding field of research has sought to understand this enigmatic condition. Although there are two clinical domains that characterise autism, less than 10% of research has taken the restricted, repetitive patterns of behaviour, interests or activities domain as its focus (Kasari & Lawton, 2010), despite carers and professionals describing this as the most difficult set of symptoms to manage (Bishop et al., 2007; Lecavalier, Leone, & Wiltz, 2006; South, Ozonoff, & McMahon, 2005). One reason for the relative paucity of research into the behavioural and conceptual phenomena encompassed by the restricted, repetitive patterns of behaviour, interests and activities domain is the absence of a theoretical framework to best understand their function and mechanisms. Extending the theoretical frameworks and empirical findings from research into behavioural and

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mental habits offers an exciting opportunity to gain insights into the restricted, repetitive patterns of behaviour, interests and activities in autism. The present chapter will consider the parallels between behavioural and mental habits with the restricted, repetitive patterns of behaviour, interests and activities which are a defining feature of autism. Firstly we will summarise what is known about the restricted, repetitive patterns of behaviour, interests and activities domain in autism (for a detailed review see Leekam, Prior, & Ulkarevic, 2011). We discuss 'higher order', compared to 'lower order', repetitive behaviours and how they are measured. Repetitive behaviours are then considered within their typical developmental trajectory, focussing upon what their functions may be. Should repetitive behaviour become problematic, or pathological, we then consider interventions in addition to potential theoretical accounts, including the Executive Functioning and Dual Process theories of autism. Finally, we explore the automaticity that is argued to be a central component of habits (in addition to repetition) and the extent to which 'mental habits' may facilitate a better understanding of 'higher-order' repetitive behaviours in autism.

Classification and Taxonomy

Repetitive behaviour (RB) in the context of autism is a descriptive term used to denote behaviour which is repeated in an invariant manner, is topographically consistent, and appears functionless in that its meaning is not immediately clear to the observer (Turner, 1999). The term encompasses a wide range of behavioural phenomena from stereotyped motor behaviour such as rocking or self-biting to adherence to a complex sequence of routines to a preoccupation with, and difficulty shifting, a pattern of thinking or belief system. Turner proposed two main categories or sub-types of RB, 'lower order' referring to stereotypies and sensory-motor behaviours and 'higher order', denoting repetition at a conceptual level such as a preference for routine. The Diagnostic and Statistical Manual-5th Edition text revision (DSM-V, APA, 2013) requires that two of four categories or sub-divisions of restricted, repetitive patterns of behaviour, interests and activities are evidenced for this part of the diagnostic threshold for autism spectrum disorders (in addition to social communication deficits): (i) stereotyped motor movements, use of objects or speech, (ii) insistence on sameness, inflexible adherence to routines or ritualized patterns of verbal or nonverbal behaviour, (iii) highly restricted, fixated interests that are abnormal in intensity or focus and (iv) hyper- or hypo- reactivity to sensory input or unusual interests in sensory aspects of the environment. The sensory-motor aspects identified in the DSM-V (i) and (iv) criteria map onto Turner's lower-order category of repetitive behaviour, whilst the conceptual aspects identified in the DSM-V (ii) and (iii) criteria map onto Turners higher-order category of repetitive behaviour. For the remainder of this chapter we will use the term 'repetitive behaviours' to refer to the full range of restricted, repetitive patterns of behaviour, interests and activities characteristic of autism. The term 'lower order' will be used to refer to sensory-motor repetitive behaviours such as repetitive finger movements or

stereotyped touching of preferred textures, and 'higher order' will be used to refer to behaviours reflecting conceptual repetition such as routinized activities or pursuit of intensely focused and circumscribed interests.

This lower-order and higher-order categorization of repetitive behaviours broadly corresponds to the sub-types of restricted repetitive behaviours enquired about in the most widely used diagnostic tool—the Autism Diagnostic Interview (ADI-R) (Lord, Rutter, & Le Couteur, 1994). A factor analytic study of the repetitive behaviour items on the ADI-R (Cuccaro, Shao, Grubber et al., 2003) established two distinct item groupings or factors. Factor I was termed repetitive sensory-motor behaviours (commensurate with lower-order repetitive behaviours) and Factor 2 was termed a resistance to change/insistence on sameness (commensurate with higher-order repetitive behaviours). Five items loaded onto Factor I: *Hand and finger mannerisms, unusual sensory interests, repetitive use of objects or parts of objects, Other complex mannerisms or stereotyped body movements; Rocking.* Three items loaded onto Factor II: *Difficulties with minor changes in routine or personal environment, Resistance to trivial changes in the environment; Compulsions/Rituals.* In the Cuccaro et al. (2003) study of 207 children with autism, the lower-order and higher-order factors were not found to be correlated, leading the authors to conclude that they may represent relatively independent constructs (see also Harrop et al., 2014). The behavioural phenomena encompassed by Factor 1 (lower order) were negatively associated with adaptive functioning, suggesting that lower-order repetitive behaviours may be an index of general developmental delay. Lower-order repetitions have been found to occur as frequently in children with general developmental delay (Mooney, Gray, & Tonge, 2006; Richler, Bishop, Kleinke et al., 2007) and children with a number of genetic conditions (Moss et al., 2009) as children with autism. Thus lower-order repetitions are not autism-specific and are attributable to developmental delay, intellectual disability and impaired language issues. Higher-order repetitions, on the other hand, are thought to be autism-specific.

Leekam, Prior, et al. (2011) review the methodological issues raised by this two factor classification. Importantly they highlight the potential for bi-directional relationships between lower-order and higher-order RBs. For example, a challenge to a higher-order insistence on sameness, may result in a lower-order rocking to and fro. In addition, repetitive verbal behaviour is not well dealt with by this two factor classification. Sometimes labelled 'high level verbal stereotypies', and frequently in the form of repetitive questions, these can be sophisticated in content and from the observer's perspective, seemingly used strategically in social communicative situations. This introduces additional issues reflected by the debate in the literature about the independence of the social communication and repetitive behaviour domains in autism. Genetic studies situate some clear blue water between the traits in population-based studies (Ronald et al., 2006), which has led to the question 'Is it time to give up on a single explanation of autism?' (Happé et al., 2006). Many theoretical accounts of autism have either focused upon the deficits in social communication OR the patterns of repetitive behaviour (see theory section below). However, clinical epidemiological studies of autistic people are less confident, and the two domains of impairments, separable in measurement terms, are useful as a means of concep-

tualizing aspects which contribute to the 'autistic whole'. Furthermore, the neurocognitive differences in autism present researchers with methodological issues in either eliciting first-person phenomenological accounts, or clearly delineating and isolating specified theoretical constructs in measurement methods.

Measurement of Higher-Order and Lower-Order Repetitive Behaviours

The heterogeneity of repetitive phenomena in autism presents complexities in terms of developing well standardized measures that can be used across cultures and studies. The majority of studies have used parental/informant reports as a basis for measurement with either broad categories of behaviour and example items employed as a structure, or questionnaires where behavioural phenomena are operationalised in terms of the parts of the body emphasized in the movements. Instruments which have been developed for use in research include the repetitive behaviours domain of the Autism Diagnostic Interview (ADI-R) (Lord, Rutter, & Le Couteur, 1994); the Childhood Routines Inventory (CRI; Evans et al., 1997); the Compulsive Behaviours Symptom Checklist of the Child version of the Yale Brown Obsessive Compulsive Scale (C-YBOCS), the Sameness Questionnaire (Prior & Macmillan, 1973), the Repetitive Behaviours Interview (RBI; Turner, 1999), the Repetitive Behaviour Scale (RBS-R; Bodfish, Symons, & Lewis, 1998) and Repetitive Behaviour Scale-Revised (RBS-R: Lam & Aman, 2007) and the Repetitive Behaviour Questionnaire (RBQ; Honey, McConachie, Turner, & Rodgers, 2012; Turner, 1995) and the RBQ-2 (Leekam, Tandos, et al., 2007). A self-report version of the RBQ (RBQ-2A) (Barrett et al., 2015) is a standardised self-report measure for able young people and adults. Direct observation has also been used as part of the widely used semi-structured clinical assessment and research tool, the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) and a small number of studies have used direct observation and time sampling methods within the framework of behavioural analysis to measure and investigate repetitive behaviours. Thus, research efforts have attempted to bring order to the heterogeneity of repetitive behaviours by investigating questions of phenomenological, conceptual, taxonomic, epidemiological and functional similarity at a group level across this diverse range of phenomena.

Developmental Issues

Chronological age is an important factor when considering repetitive behaviour in autism in addition to developmental delay/level. Militerni, Bravavvio, Falco, Fico, and Palermo (2002) found that younger autistic children were more likely to show lower-order repetitive behaviours with older autistic children more likely to show higher-order repetitive behaviours. Lam and Aman (2007) found that while

self-injurious behaviour and compulsions were comparable across age groups in autism, stereotyped movements and restricted interests were less frequently observed, and ritualistic or sameness behaviour more frequently observed, in older age groups. In an attempt to further understand the role of intellectual impairment and age, Esbensen, Seltzer, Lam, and Bodfish (2009) combined data from a number of studies using the RBS-R to conduct a large (n = 712) cross-sectional analysis of repetitive behaviours. The sample ranged from 2 to 62 years of age and 62.2% had intellectual disability in addition to autism. The authors found that the adults in the study showed fewer of all types of repetitive behaviours as measured by the different sub-scales of the RBS-R repeating the finding that increasing age is associated with decreasing repetitive behaviours. The age-related reduction was most marked for the restricted interests sub-scale. Again the authors established in their data set that intellectual disability was significantly associated with repetitive behaviour, in particular with lower-order repetitive behaviours and this domain showed a less pronounced reduction with age when intellectual disability was present. Bishop, Richler, and Lord (2006) also sought to understand the interaction between age, intellectual ability and restricted repetitive behaviours in a group of 830 children with autism. On this occasion the upper age limit was 12 years and non-verbal abilities were taken as an index of cognitive function. The authors found that non-verbal ability was significantly negatively correlated with lower-order repetitive behaviours such as unusual sensory interests, hand and finger mannerisms, self-injury, repetitive use of objects and other complex mannerisms. However, higher-order repetitive behaviours such as circumscribed interests and compulsions and rituals were more commonly reported in children with higher non-verbal ability. Overall, therefore, these findings are consistent with the proposal that lower-order repetitive behaviours are associated with developmental delay and impaired cognitive ability generally, whereas higher-order repetitive behaviours are autism-specific and persist into the later developmental period.

‘Normal’ and ‘Pathological’ Levels of Repetitive Behaviour

Repetitive behaviours are very much a part of typical development (Piaget, 1950), easily observed during the first year of infancy (Thelen, 1979) and declining after 48 months (Evans et al., 1997). Repetitive behaviours are also common in healthy adults, where stereotypies or seemingly pointless, habitual repetitive movements are evident, particularly where an individual is bored or under stress (Asendorpf, 1980; see also Chap. 9 in this volume). Repetition is an important aspect of almost all levels of behaviour across all species but can become pathological if there is excessive occurrence of a behavioural programme or, when there is a lack of self-initiated, variable and novel behaviour. Pathological repetition can occur at many levels of function ranging from the observable excessive occurrence of simple motor acts (lower order) and difficulties at the conceptual or organizational level, perhaps in planning and strategy formation (higher order). Pathological repetitive behaviours have been observed across a number of clinical conditions including

Schizophrenia (Frith & Done, 1983), and Frontal Lobe Syndrome (Luria, 1973) amongst others. Although higher-order repetitive behaviours are more common in autistic people than typically developing people, it is not clear if they are truly 'pathological' or an understandable, functional part of the autism picture. Research has sought to consider how repetitive behaviours in autism depart from the repetitive behaviours observed in typical development. General population studies (e.g. Evans et al., 1997; Leekam, Tandos, et al., 2007) have found using standard measurement tools that typically developing children between ages 2 and 3 years show a wide range of repetitive behaviours associated with autism. The break with typical development in autism is thus temporal rather than qualitative, at least in young children. The departure from typical development may be better understood as a failure to develop novel behaviours and hence repetitive behaviour continues without cessation. This would seem to be the case for lower-order repetitive behaviours in those with intellectual disability and developmental delay (with or without autism) and for higher-order repetitive behaviours in those with autism.

Thus, repetitive behaviours are part of typical development in the early years. Lower-order repetitive behaviours appear to be associated with general developmental delay once the peak of non-pathological repetition has passed at age 48 months and may represent stimulus-driven rather than 'willed' behaviours. Within autism however, increasing age is associated with decreasing occurrence of lower-order repetitive behaviours, whilst higher-order repetitive behaviours seem to be more likely in autistic people of average intellectual ability (or above).

Functions of Repetitive Behaviour

One avenue of research into repetitive behaviours has been to try and understand why they are being initiated, that is, their function. Recent research of repetitive behaviours in autism has proposed that repetition may serve to reduce chronically high anxiety levels in autism. Whilst anxiety is not a diagnostic characteristic of autism, anxiety occurs at clinically significant levels in around two thirds of autistic people (Simonoff et al., 2008). Rodgers et al. (2017) found a significant association between scores on the Repetitive Behaviour Questionnaire (RBQ), particularly the higher-order sub-scale and total scores on the Spence Children's Anxiety Scale (SCAS) in a group of 67 young people with autism. Lidstone et al. (2014) similarly found that a significant association between RBQ-2 and anxiety scores reflected a significant correlation between the higher-order sub-scale and anxiety, but not the lower-order sub-scale. Neither study measured symptoms of Obsessive Compulsive Disorder (OCD), a potential confound with high rates of obsessive-compulsive symptoms reported in autistic people (McDougle et al., 1995; Russell et al., 2016). The issue of anxiety-based obsessive-compulsive symptoms represents a potential confound of some complexity when investigating repetitive behaviours in autism and has become a field of research in its own right (e.g. Zandt, Prior, & Kyrios, 2007). As well as high rates of anxiety disorders, particularly social anxiety, high

rates of OCD have been reported across the lifespan in autism (Zandt et al., 2007). OCD comprises repeated, unwanted, intrusive thoughts associated with distress and compulsions, actions which an individual feels compelled to perform, often in response to obsessions. Heavily reliant on self-report, obsessive-compulsive symptoms in less verbally able children and adults with autism can be difficult to disentangle from some forms of repetitive behaviours. Nonetheless, there is vast empirical evidence demonstrating the role of anxiety in the development and maintenance of OCD and consequently studies considering the function of repetitive behaviours in autism need to be mindful of anxiety-based obsessive-compulsive symptoms.

Interventions for Repetitive Behaviours

Despite the prominence of repetitive behaviours in autistic children (and adults) and the associated management challenges for parents, care-givers and service providers (Bishop et al., 2007; Lecavalier et al., 2006; South et al., 2005), repetitive behaviours are rarely targeted for intervention and no standardized recommendations for treatment exist (see Boyd, McDonough, & Bodfish, 2012; Leekam, Prior, et al., 2011 for reviews). One of the reasons repetitive behaviours can be 'treatment resistant' is a failure to consider WHY the autistic person is engaging in repetitive behaviours, i.e. considering their function (Leekam, Prior, et al., 2011). Militerni et al. (2002) in a study aiming to understand the function of, or environmental factors associated with, repetitive behaviours in a relatively large sample of young autistic children (n = 121) used a combination of parental report and direct clinic observation. The authors found that simple, motor sequences seemed to be relatively purposeless and consistent with behaviours observed in typical development, while sensory-based behaviours presented as highly reactive, either to environmental or internal cues. Also carefully delineating repetitive phenomena according to behavioural topography may not be ideal. In operant accounts, very different behaviours can share the same functional class. Conversely a single behaviour can have many different functions. Of note, the authors could identify no studies where able young people and adults' accounts of why they do what they do have been subject to systematic enquiry.

Thus whilst repetitive behaviour may be perceived to be the most challenging aspect of autism for parents/carers, this may not be the case for autistic individuals themselves. If the function of a higher-order repetitive behaviour is to reduce anxiety, intervening to disrupt the higher-order repetitive behaviour may have adverse impact upon anxiety levels in the autistic individual. Within the literature on challenging behaviour (generally, not repetitive behaviour specifically), again research has highlighted how identifying the function of the behaviour that is perceived to be challenging is crucial for successful intervention. Challenging behaviour is a descriptive term for '*culturally abnormal behaviour of such an intensity, frequency or duration, that the physical safety of the person or others is placed in serious jeopardy or behaviour which is likely to seriously limit the use of, or result in the*

person being denied access to ordinary community facilities' (Emerson, 2000). Challenging behaviour can be understood within operant learning theory as purposeful behaviour, a means by which a person with compromised resources seeks to exercise some choice and control over their environment. Hence it is a form of behaviour which is shaped and maintained by environmental events. Challenging behaviour functions to access a desired event or avoid an undesired event, with reinforcement processes highlighted by the contingent relationship between behaviour and antecedent factors, and/or consequences. A commonly used assessment tool, the Motivation Assessment Scale (MAS: Durand & Crimmins, 1992) ascribes four main functional categories to a target behaviour, namely: sensory motivated behaviours, demand-escape, access to attention, and access to tangible resources. Functional analysis is a highly individualised process, and behaviours which are topographically similar across individuals may fulfil very different functions, with the converse also holding true. There is no reason to suppose that repetitive behaviours can be ascribed the same function across all autistic people but it is plausible that there may be formulations which are common to numbers of people with autism. For example, insisting on a highly routinized performance of an activity such as taking the same route to school each day may function to avoid the anxiety emerging from uncertain interactions or events on a novel route. Alternatively, it may be that the preferred route provides access to objects of intense interest or pleasure. Alternatively, repetitive behaviours may function to reduce access to unwanted social attention and communication by facilitating disengagement from interpersonal situations, they may be a source of internal stimulation or a means of escape from or coping with a demanding sensory environment.

Theory

Much theoretical work on autism has focussed upon the social communication deficits or an attention to local detail at the cost of global details (e.g. Baron-Cohen, Leslie, & Frith, 1985; Happé & Frith, 2006). The Theory of Mind account of autism, for example, proposes relative impairments in the ability to make inferences about mental states such as the thoughts, beliefs and intentions of others. Theory of Mind abilities are assumed to extend intra- as well as inter-personally. It is assumed that difficulties making inferences about the mental states of others are accompanied by similar difficulties in reasoning about one's own mental state. Whilst not explicitly addressing repetitive behaviours, Theory of Mind may be pertinent as Williams and Happé (2010) attribute impairments in self-Theory of Mind (or 'metacognition') in autism in an inability to distinguish reflex behaviour from intended behaviour. When eliciting the classic knee-jerk reflex by tapping the knee with a hammer, autistic people were more likely to report that they had intended to jerk their leg. There was an apparent deficit in distinguishing one's intention between automatic and non-automatic behaviours (see also Brosnan, Johnson, et al., 2016; Maras, Gamble, & Brosnan, 2017). As noted above, deficits in metacognition can also impact upon researchers' capacity to ask autistic people why they engage in repetitive behaviours.

There are two theoretical accounts of autism that may relate more directly to repetitive behaviours, although evidence is mixed. The first is the Executive Function (EF) theory of autism. EFs refers to the neuropsychological processes critical to goal-directed, future-oriented behaviour, thought to be under the control of the frontal regions of the brain and described by Shallice and Burgess (1991) as the abilities involved in planning and strategy formation, flexibility, inhibition of pre-potent responses and generation of novel responses. Studies have identified impairments in the majority of these functions in autism and a recent meta-analysis concluded an effect of overall impairment in EF in autism, with little evidence for a selective impairment in terms of fractionation of EF (Demetriou et al., 2018). There has been research investigating the relationship between facets of EF and repetitive behaviours. For example, Turner (1999) found a significant association between scores on Use of Objects, Ideational and Design Fluency (generativity tasks) and repetitive behaviours. Conversely, Lopez, Lincoln, Ozonoff, and Lai (2005) found that it was cognitive flexibility which had a unique contribution to repetitive behaviour scores not planning and generativity. Other researchers have found no association between EF deficits and repetitive behaviours (e.g. Boyd, McBee, Holtzclaw, Baranek, & Bodfish, 2009; Dichter, Lam, Turner-Brown, Holtzclaw, & Bodfish, 2009; Zandt, Prior, & Kyrios, 2009). Thus whilst perseveration associated with EF deficits may have an intuitive appeal for an account of the maintenance of higher-order repetitive behaviours in autism, evidence is far from consistent.

The second theory of autism that may be relevant to repetitive behaviours is the Dual Process Theory of Autism (Brosnan & Ashwin, 2018; Brosnan, Ashwin, & Lewton, 2017; Brosnan, Lewton, & Ashwin, 2016). Within Dual Process Theory (Evans & Stanovich, 2013), the dual processes are Type 1 processing, which is preconscious, automatic and rapid, and Type 2 processing, which is conscious, deliberative and slow. Typically, people engage in Type 1 processing unless overridden by Type 2 processing. The Dual Process Theory of Autism proposes that autism is characterised by a dominance of Type 2 processing over Type 1 processing. Through a range of tasks, autistic people consistently demonstrate Type 2 behaviour in situations where Typically Developing people demonstrate Type 1 behaviour. Typically people can be encouraged to engage in Type 2 behaviour and over-ride their prepotent Type 1 response (for example by being told to reflect upon a situation and write down why they are responding in a certain way). It is unknown whether autistic people are over-riding Type 1 processing with dominant Type 2 processing or whether Type 1 processing is impaired (or absent). Under this framework, it is the intuitive 'automatic' aspects of Theory of Mind (see above) in rapid dynamic real world situations that pose difficulties for many autistic people. Many social communication deficits are seen as deficits in automatic processing. There can also be many strengths associated with autism, such as great attention to detail or a preference for logical, systematic thinking which is consistent with a preference for Type 2 processing.

One advantage of Type 2 processing is that it supports the capacity to make effective predictions and minimise prediction error (see Baron-Cohen, Ashwin, Ashwin, Tavassoli, & Chakrabarti, 2009). Making prediction errors correlates with higher levels of anxiety in autistic people (Garfinkel et al., 2016), and engaging in Type 2 processing may relate to a strategic attempt to minimise prediction errors

and anxiety. However this is only effective in contexts that allow the time required to engage in Type 2 processing. Social situations are typically very rapid and draw upon automatic Type 1 processing to be effective. There is good evidence that autistic people engage in Type 2 processing in contexts in which typically people engage in Type 1 processing (such as social contexts) which is extremely effortful and often unsuccessful in real world situations (see Harms, Martin, & Wallace, 2010). Speculatively, engaging in repetitive behaviours may be a mechanism by which novelty is minimised and prediction errors are minimised. This theorises a potential relationship between Type 2 processing and repetitive behaviours which may be more pertinent for higher-order cognition and consequently the autism-specific higher-order repetitive behaviours. Within the Dual Process Theory of higher-order cognition (Evans & Stanovich, 2013), there are multiple Type 1 systems of different kinds, including habitual forms of processing. A greater understanding of habits will therefore inform a more detailed understanding of repetitive behaviours in autism, specifically higher-order repetitive behaviours.

Habits

Verplanken's habit research has focussed upon the function of the habit (Verplanken & Orbell, 2003) and may therefore be particularly pertinent for better understanding restricted behaviours in autism. A habit can be defined as behaviour contextually cued, without conscious thought, via activation of a mental context-behaviour association learned through context-consistent performances (see Gardner, 2015). Definitions vary as to whether a habit is defined as a type of behaviour or as a type of automaticity—that is a cognitive mechanism independent of behaviour (Verplanken & Wood, 2006; Wood & Neal, 2009; see also Chap. 2 in this volume). Gardner (2015, p. 280) proposes that such definitional differences can be resolved by viewing habit as 'a process by which a stimulus automatically generates an impulse towards action, based on learned stimulus-response associations'. Also pertinent from Verplanken's (Verplanken, 2006; Verplanken, Friborg, Wang, Trafimow, & Woolf, 2007; see also Chap. 15 in this volume) research is the proposal of 'mental habits' that may be a useful framework for considering the autism-specific higher-order repetitive behaviours. Mental habits are considered in terms of mental process distinguished from mental content. Verplanken et al. (2007) propose that mental habits are unintended, are initiated without awareness, are difficult to control and are distinct from rumination and mindfulness. The authors focussed upon a 'negative self-thinking habit' that predicted anxiety symptoms 9 months later (in addition to other factors). This framework invites the initial question as to the extent to which higher-order repetitive behaviours in autism are unintended, initiated without awareness and difficult to control.

Thus Verplanken et al. argue that although a history of repetition is part of the habit concept, repetition alone is not enough to qualify a behaviour as habit. Repetitive behaviours in autism are present from early childhood, and thus by defi-

nition autistic repetitive behaviour has a history of repetition. Verplanken & Orbell (2003) argue that most conceptual definitions of habit contain other elements in addition to behavioural frequency, most notably the qualification of habit as behaviour that has acquired a certain degree of automaticity. Within this view, automaticity may be broken down into four features: (1) lack of awareness; (2) mental efficiency; (3) lack of control; and (4) lack of conscious intent (the 'four horsemen of automaticity'). The presence or absence of each of these features yields a variety of variants of automaticity. So, what pattern of automaticity characterises repetitive behaviour in autism (or how autistic are the four horsemen of automaticity)?

A Lack of Awareness

Autism has been associated with impairments in metacognition, which can manifest as a lack of self-awareness. Difficulties interpreting your own feelings and intentions (see Theory of Mind, above) may relate to a lack of awareness of repetitive behaviours. The extent to which an autistic person is aware they are engaging in repetitive behaviours may be a feature of whether lower-order or higher-order behaviours are being considered as well as the function of the repetitive behaviour. Systematic studies of first-person introspective accounts on this aspect are few and far between and thus the extent to which autistic people are aware of their autism-specific higher-order repetitive behaviour remains an unanswered question.

Being Mentally Efficient

We have observed in this chapter, that autistic people may be reliant on Type 2, effortful processing and this may be particularly true in respect of social stimuli. An effortful processing style may be associated with an enhanced need for mental efficiency at other times, perhaps in the form of cognitive 'down-time'. It seems plausible that repetitive mental and behavioural acts may counter-balance the periods of effortful processing by providing periods of efficient, predictable and more automatic processing. Thus repetitive behaviours in autism may provide us with a window into the optimal balance of effortful versus automatic processing required by humans to manage limited information processing capacity.

Sometimes Difficult to Control

Autistic people can have a focused interest on a particular topic which can be enjoyable and stimulating. However, these interests can also significantly interfere with everyday functioning (Mercier, Mottron, & Belleville, 2000), which may be some

indication that this focused interest mentally and behaviourally is not be entirely under an individual's control. Mercier et al. found that autistic adults reported that restricted interests played a significant role in their lives that was acknowledged by most of their relatives. They provided a sense of well-being, a positive way of occupying one's time, a source of personal validation, and an incentive for personal growth. However, these positive dimensions were counterbalanced by their negative consequences, resulting in active processes to adapt, reduce or diversify their restricted interests.

A Lack of Conscious Intent

Lower-order repetitive behaviour is more likely to be stimulus-bound, a rapid response to internal (e.g. anxiety) or external (e.g. environmental opportunity) cues and thus lacking in conscious intent. Whether higher-order autistic repetitive behaviours are associated with a lack of conscious intent presents an interesting question. Behaviours which are engaged in pursuit of a circumscribed interest e.g. seeking out items of interest or mentally listing all the preferred characters in a film will require conscious intent. Whether the preference for a restricted range of interests and activities is consciously intended or part of a neurobiological constitution is less certain. Thus, if autism is characterised by a restricted range of mental habits (repetitive thinking), the restriction may be without conscious intent, whereas the repetition may be with conscious intent.

Considering the four horsemen of automaticity from the habit literature may therefore be informative for understanding repetitive behaviour in autism, specifically how the automaticity of mental habits may relate to higher-order, autism-specific repetitive behaviours. Firstly, a history of repetition is a defining feature of autism. The level of awareness and conscious intent is an interesting area as it seems likely that an autistic person with a circumscribed interest will be aware of this interest or will be aware that they have a preferred route for going home from school (for example). It also seems likely that this would be accompanied by a conscious intent to talk about their circumscribed interest or to adhere to their routine. This may be rewarding in itself as well as anxiety reducing and potentially difficult to control. However, it may be that the autistic person is not motivated to control the repetitive behaviour, whereas family members may be motivated to try and do so. Many of the interventions to address repetitive behaviours address 'challenging repetitive behaviours', which are typically challenging to the family (and may have a function for the autistic individual). Being mentally efficient also raises interesting questions. Dual Process Theory proposes that habitual thinking is an automatic Type 1 process, however the Dual Process Theory of Autism proposes a bias away from automatic Type 1 processing.

Thus habits and repetitive behaviours may share a history of repetition, but may be distinguished from each other in terms of automaticity. The presence or absence of each of the 'four horsemen of automaticity' is argued within the mental habits literature to yield 'a variety of variants of automaticity'. It is an intriguing hypoth-

esis that mental habits might represent automatic Type 1 processing whereas autistic higher-order repetitive behaviours might represent automatic Type 2 processing. It would be fascinating if effortful processing was the default in autism, that is 'automatic' in the sense that it is not initiated after Type 1 processing. Within this framework we could speculate that a drive for repetition minimises cognitive resources (e.g. humans being 'cognitive misers'), which is typically achieved through the automaticity of (Type 1) mental habits. However, higher-order repetative behaviours may emerge in autism as a response to a drive for repetition combined with a bias away from the automaticity of Type 1 processing - a distinction which could be assessed emprically. The mechanisms by which habits develop (shift from Type 2 to Type 1 processing?) may therefore provide an interesting perspective. Might repetitive behaviour arise from this shift not occurring in autism? The findings that mental habits and repetitive behaviours are both related to levels of anxiety may also suggest a common function. This can have important implications for how (or if) intervention may impact upon repetitive behaviour. Can the literature on habit change inform interventions for repetitive behaviour in autism?

Framework for Habit Change

Habit change typically seeks to understand the context, the cue and the reward for the habitual routine. For example, Duhigg (2013), evokes three core components of habits; the routine, the cue and the reward. The framework for changing habits therefore is based upon these three components:

Identify the Routine

This concerns the repetitive behaviour you want to change and is typically easily identifiable, such as an insistence on sameness or routine that is problematic (noting this may be problematic for the family rather than the autistic person).

Experiment with Rewards

Our earlier discussions considering the possible functions of repetitive behaviour in autism showcase the potential for repetitive behaviours as coping strategies for a range of hypothesised stressors, such as managing chronically high anxiety levels, as a source of stimulation and pleasure when social interaction is experienced as aversive. In this context, repetitive behaviour may provide activity and structure which require less effort and thereby minimise cognitive load (and are predictable). Repetitive behaviours are at the very core of autism, and an intricate relationship between repetitive behaviour and social communication impairments is likely to

exist. There is a diagnosis of Social (Pragmatic) Communication Disorder for children who have social communication and interaction difficulties without repetitive behaviours. There are instances when repetitive behaviours can meet the definition of challenging behaviour and change is desirable for an individual's well-being and quality of life (for example repetitive damaging self-injurious behaviour, or engagement in a circumscribed interest to the exclusion of essential activities of daily living). At a more general level however, introducing change to the 'habit of repetitive behaviour' may not be an ethical or desired outcome. The 'reward' for repetitive behaviour in autism may well be more effective coping with the world. Alternative coping strategies will be required and may not be as easy to institute or as effective.

Isolate the Cue

Once again, if anxiety were the cue, biofeedback systems could serve as a mechanism to isolate the cues for repetitive behaviours. Once isolated, the cue ideally is removed from the environment. Anxiety is a sense of apprehension and is closely related to fear. It has physiological, emotional and cognitive facets and typically occurs in response to specific triggers. In the context of autism, these are often factors such as uncertainty about change, unpredictability, social interaction etc. Removing the cue by making the world a more predictable and less social place to live is inherently impractical.

If we continue with our route home example, let's suppose road works mean you have to alter your route home as you drive your child back from school. If the child starts to rock to and fro, the cue may be the internal detection of raising anxiety levels and the reward may be the alleviation of the feeling of anxiety. The context of such an explanation is crucial. The raised anxiety might be induced by an unexpected change in the environment and this lack of predictability of such change culminated in a repetitive behaviour which is predictable and thereby reduces feelings of anxiety. In this hypothetical example, the cue to the repetitive behaviour could be the detection of unexpected change or the sense of increasing anxiety. The reward could be the re-establishment of the prediction (i.e. the usual route home, not possible in this example) or a reduction in anxiety. Preventing the child engaging in the repetitive behaviour may therefore be denying them access to their only form of anxiety management. Thus the context of the repetitive behaviour—predictability or anxiety—may be crucial to understand in terms of cues and rewards. Indeed, most likely both of these aspects come into the equation. It is also possible that there are circumstances where separating the context, the cue and the reward is not possible. In cases where the behaviour is rewarding in and of itself. Sensory-motor repetitions can fit this bill, and will occur across contexts, independent of cues and automatically reinforcing.

We are left with some important questions following our attempt to map repetitive behaviours in the geography of the habit landscape. These include:

Can the different dimensions of automaticity be operationalised and reliably measured to investigate the relevance for repetitive behaviours in autism (Type 1 vs. Type 2 processing from Dual Process Theory).

How viable is a distinction between higher-order vs. lower-order repetitive behaviours, mental vs. behavioural habits. Is there a different way to conceptualise the heterogeneity of repetitive phenomena e.g. in terms of functional class or automaticity.

What is the function of higher-order repetitive behaviours or mental habits? To what extent are they anxiety management strategies?

How does the restriction in the range of behaviours, interests and activities in autism relate to repetition?

Finally, as we note above much of the motivation for repetitive behaviour research within autism has been to perceived negative (challenging) consequences. A focus upon the positive consequences may enable a better understanding of 'adaptive repetitive behaviours' rather than 'pathological habits'.

Habit Research in Action

Behavioural repetition is relatively easy to observe, and studies have relied on informant reports. Less accessible to measurement is mental repetition. Typically, investigation of habitual thinking is a matter of retrospective and reflective self-report. The validity of this method in autism is under question due to impairments in metacognition (Brosnan, Johnson, et al., 2016; Maras et al., 2017; Williams & Happé, 2010), introspective abilities and recognition of one's own emotional state. Descriptive experience sampling methodology (DESM) is a means of 'catching' internal phenomena in the moment before it is mapped or subject to heuristic processing. DESM was pioneered by Hurlburt, (1993, 1997; Hurlburt & Heavey, 2006) and was successfully used in a small study of adults with autism (Hurlburt, Happé, & Frith, 1994), which found that autistic people's thinking might be represented visually rather than verbally. We have adapted the DES method to address questions about mental repetition, specifically restricted and repetitive thinking in autism, using a structured booklet with prompt questions, space for pictures and use of a smartphone application to aid data collection (Cooper, Russell, Calley, & Verplanken, in preparation). Inductive content analysis of the mental repetition reported by able adults with autism and compared to typically developing adults will answer two simple questions: Do adults with autism have restricted categories or types of thoughts compared to non-autistic adults, and are these categories or types of thought repeated more frequently? Participant ratings of the positive or negative experience of repetitive thoughts will afford some limited insight into the nature of restricted and repetitive mental experience of autism.

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